

NOAA-USGS Land Product Validation System

STAR JPSS Science Team Meeting
14 May 2014

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Ryan Longhenry: USGS/EROS
Greg Stensaas: USGS/EROS

Landsat 8



Land Product Validation System (LPVS)

What is LPVS

Why LPVS developed/hosted at EROS

Highlights of LPVS

1. Inventory & Ordering
2. Analysis Tools

Path Forward

Summary

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Path Forward

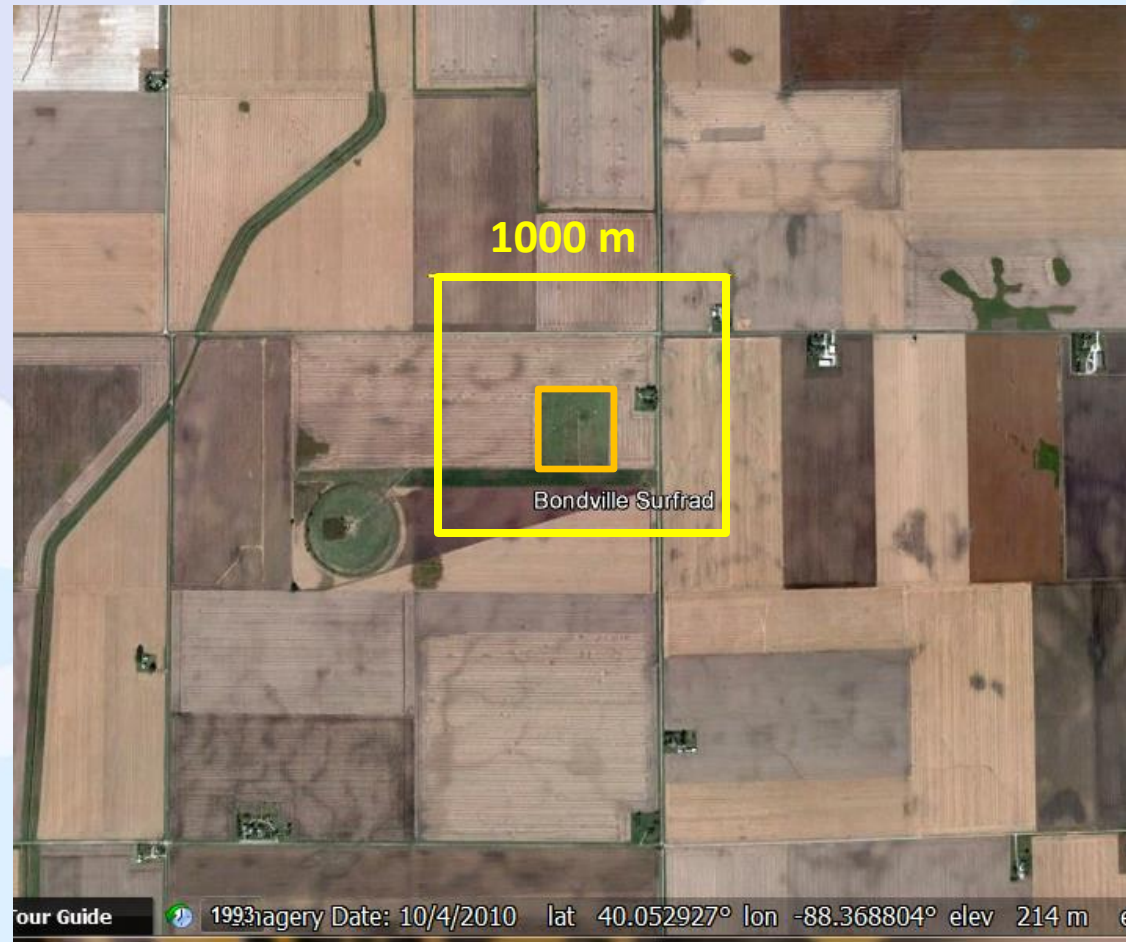
Summary

What is LPVS

1. General characteristics
2. Desired functionality

A web-based system designed to use moderate to high-resolution satellite data for validation of GOES-R ABI and JPSS VIIRS products.

Bondville, IL SURFRAD



What is LPVS

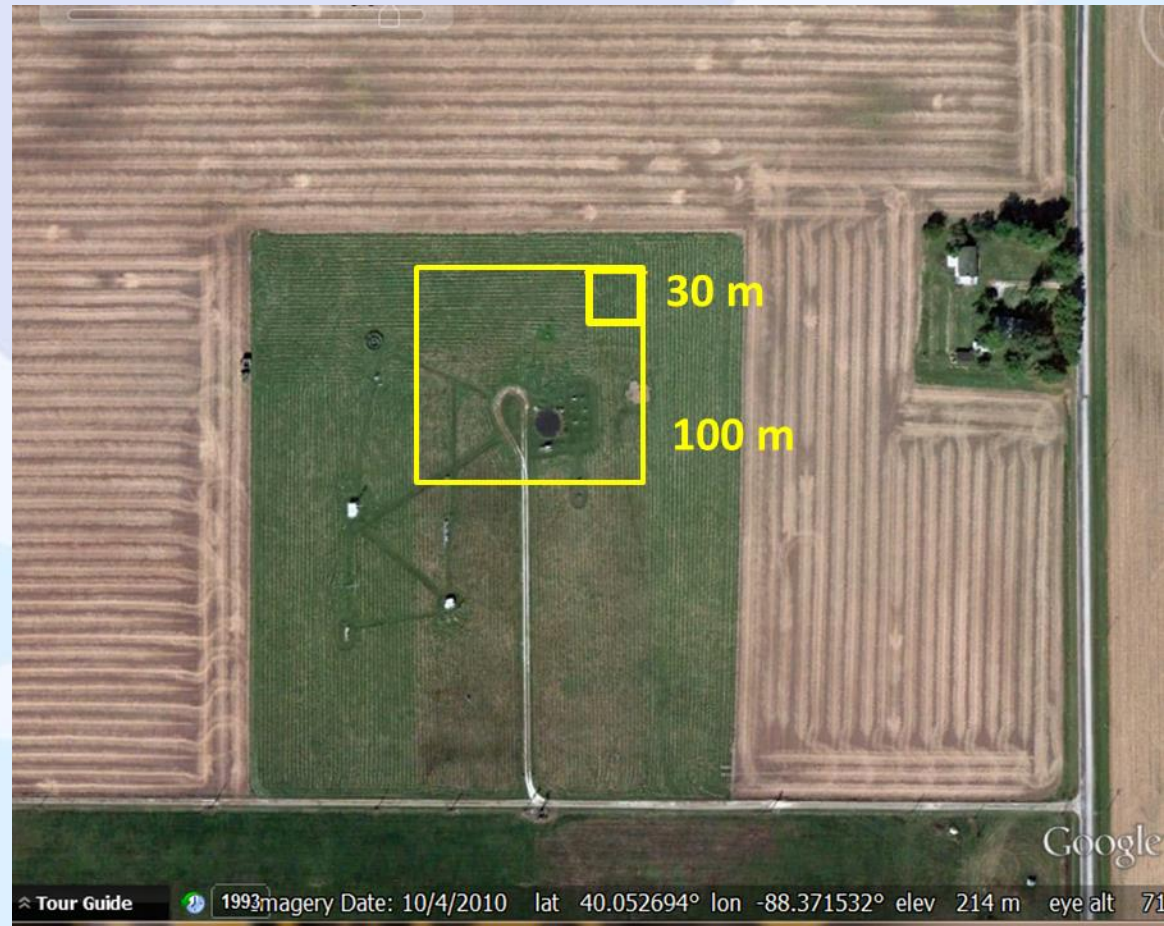
1. General characteristics
2. Desired functionality

Landsat 8 spatial resolution

vis/near IR 30 m

Thermal IR 100 m

Bondville, IL SURFRAD



What is LPVS

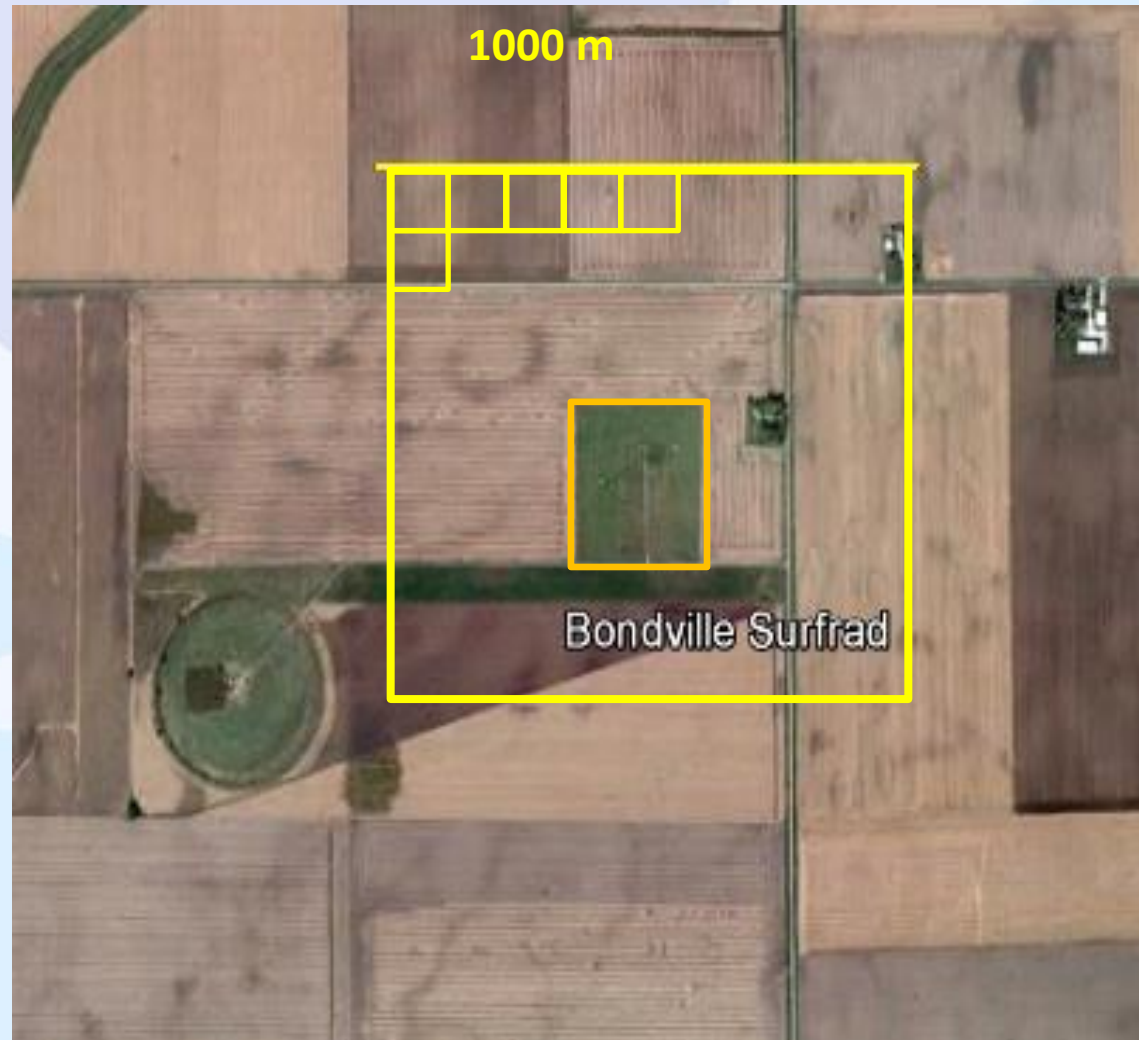
1. General characteristics
2. Desired functionality

Landsat sampling for 1000 x 1000 m target:

- 1100 samples at 30 m resolution
- 100 samples at 100 m resolution

Ready for GOES-R and JPSS-VIIRS pre- and post-launch testing and validation.

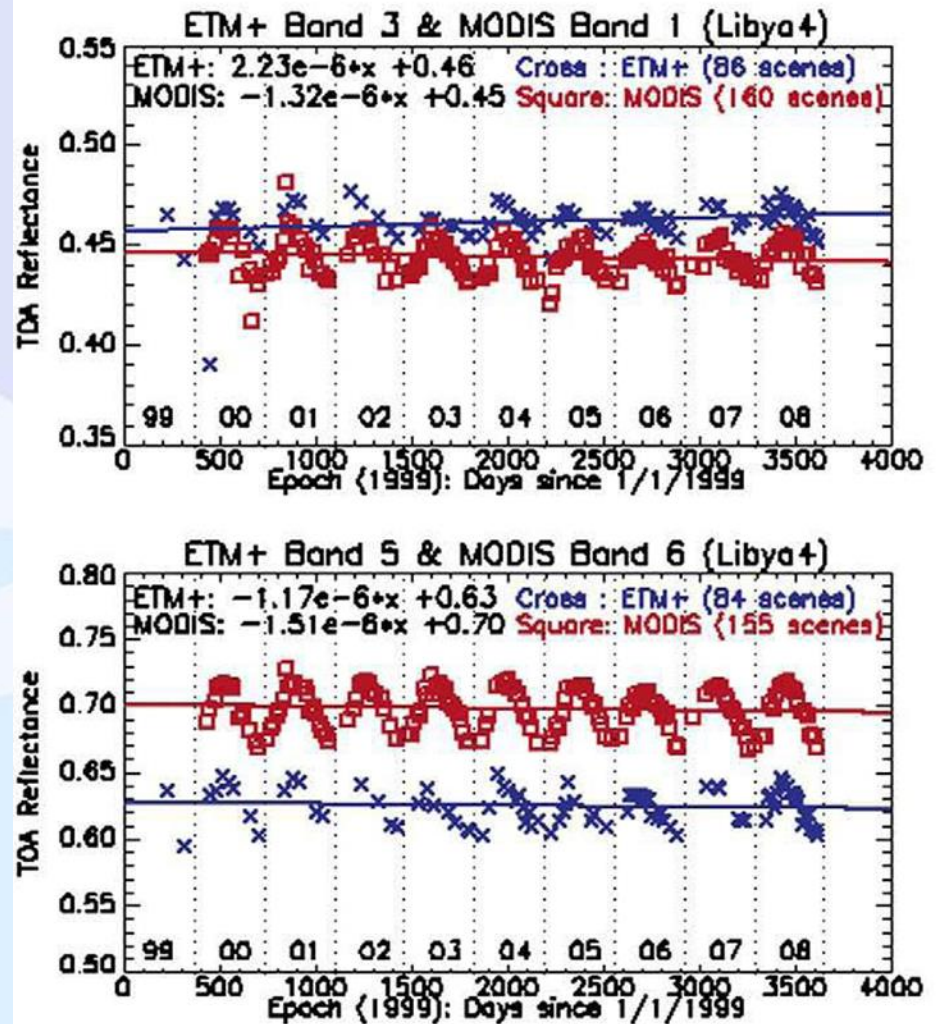
Bondville, IL SURFRAD



What is LPVS: General Characteristics

Output examples

Trending of similar bands of data from multiple sensors.

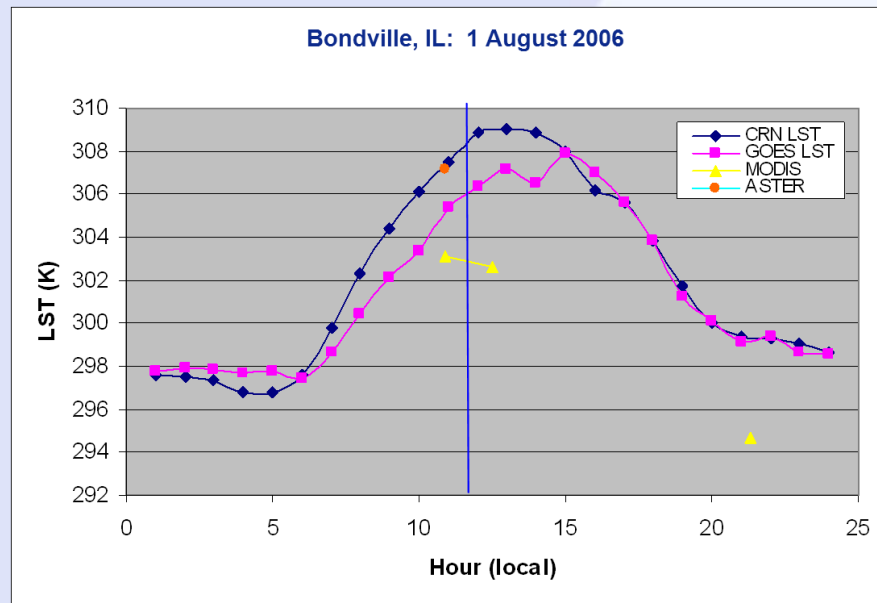


What is LPVS: General Characteristics

Output examples

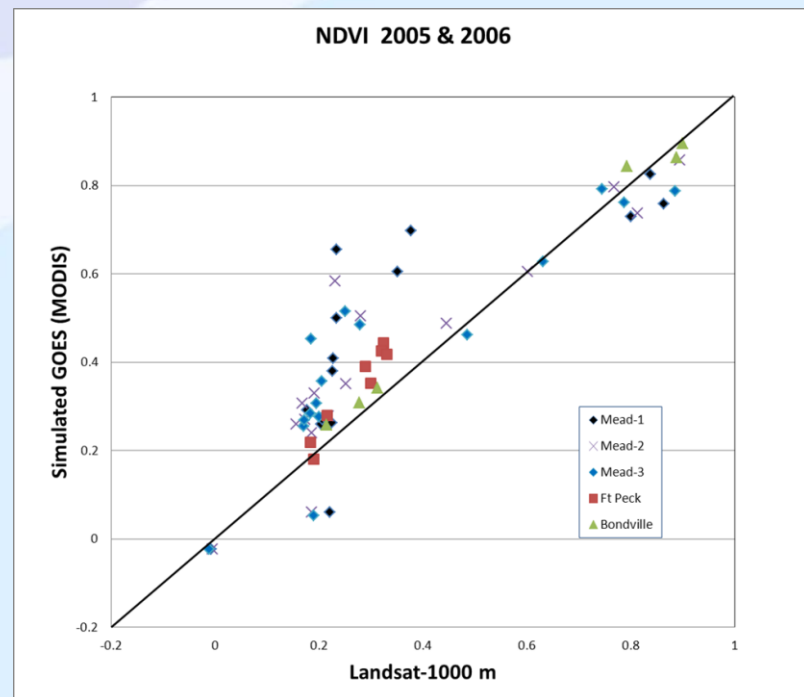
Multiple sensor (satellite and in situ) comparisons for single location and date.

Land
Surface
Temp.



Multiple sensor comparison for multiple locations and multiple dates.

NDVI



What is LPVS

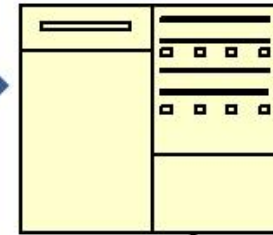
Characteristics and desired functionality

GOES-R ABI and VIIRS Land Product Validation System



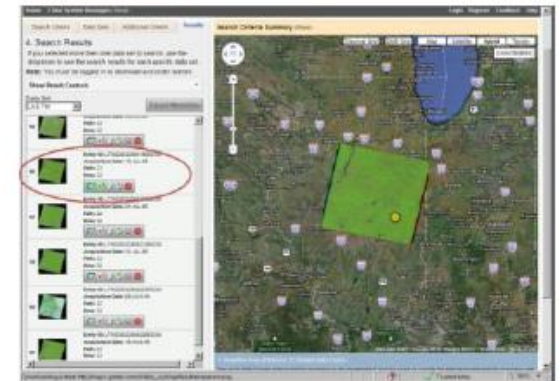
NPP & JPSS VIIRS
GOES-R ABI
Landsat-7 & -8
MODIS
Sentinel-2
others..
& In Situ

On demand data acquisition
Automated data acquisitions



Data and
Inventory
information
stored at
EROS.

Inventory
and ordering of
data

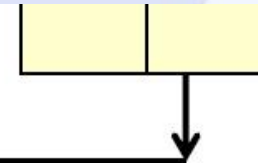
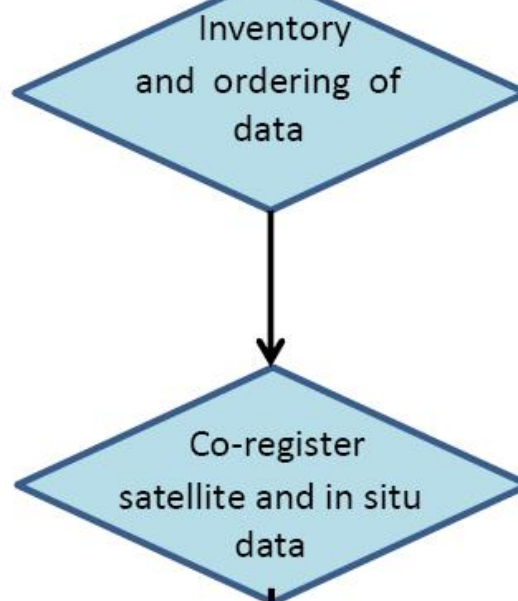


What is LPVS

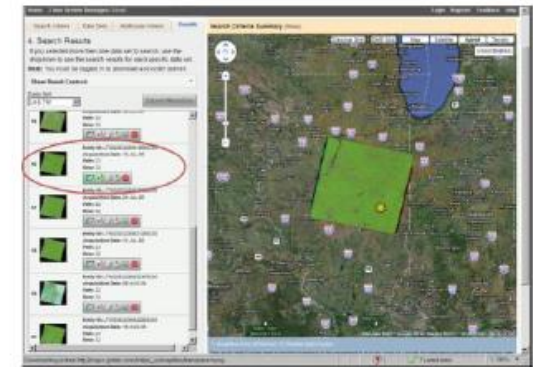
Characteristics and desired functionality

NPP & JPSS VIIRS
GOES-R ABI
Landsat-7 & -8
MODIS
Sentinel-2
others..
& In Situ

Additional Analysis



stored at
EROS.

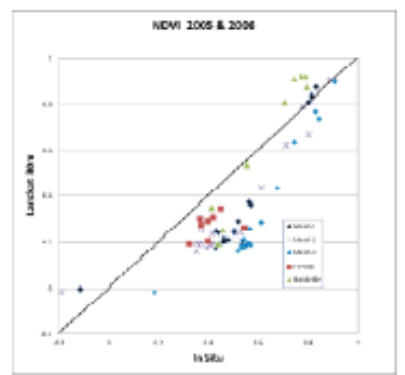
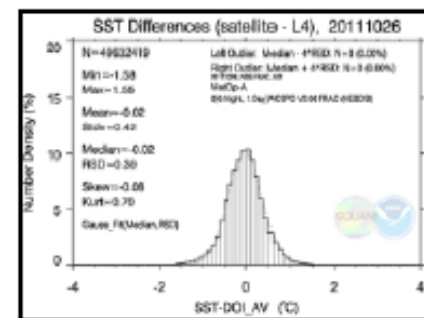
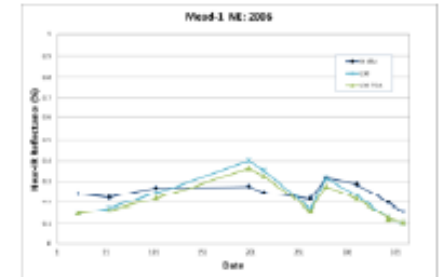
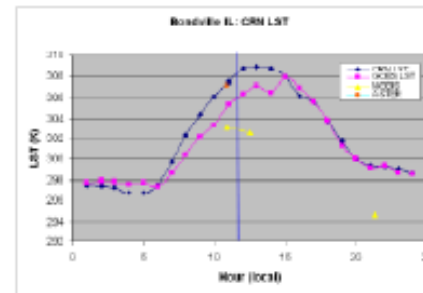


What is LPVS

Characteristics and desired functionality

Analysis of
satellite and in situ
data

Generate
statistics, charts
and reports



Land Product Validation System (LPVS)

What is LPVS

Why LPVS developed/hosted at EROS

Highlights of LPVS

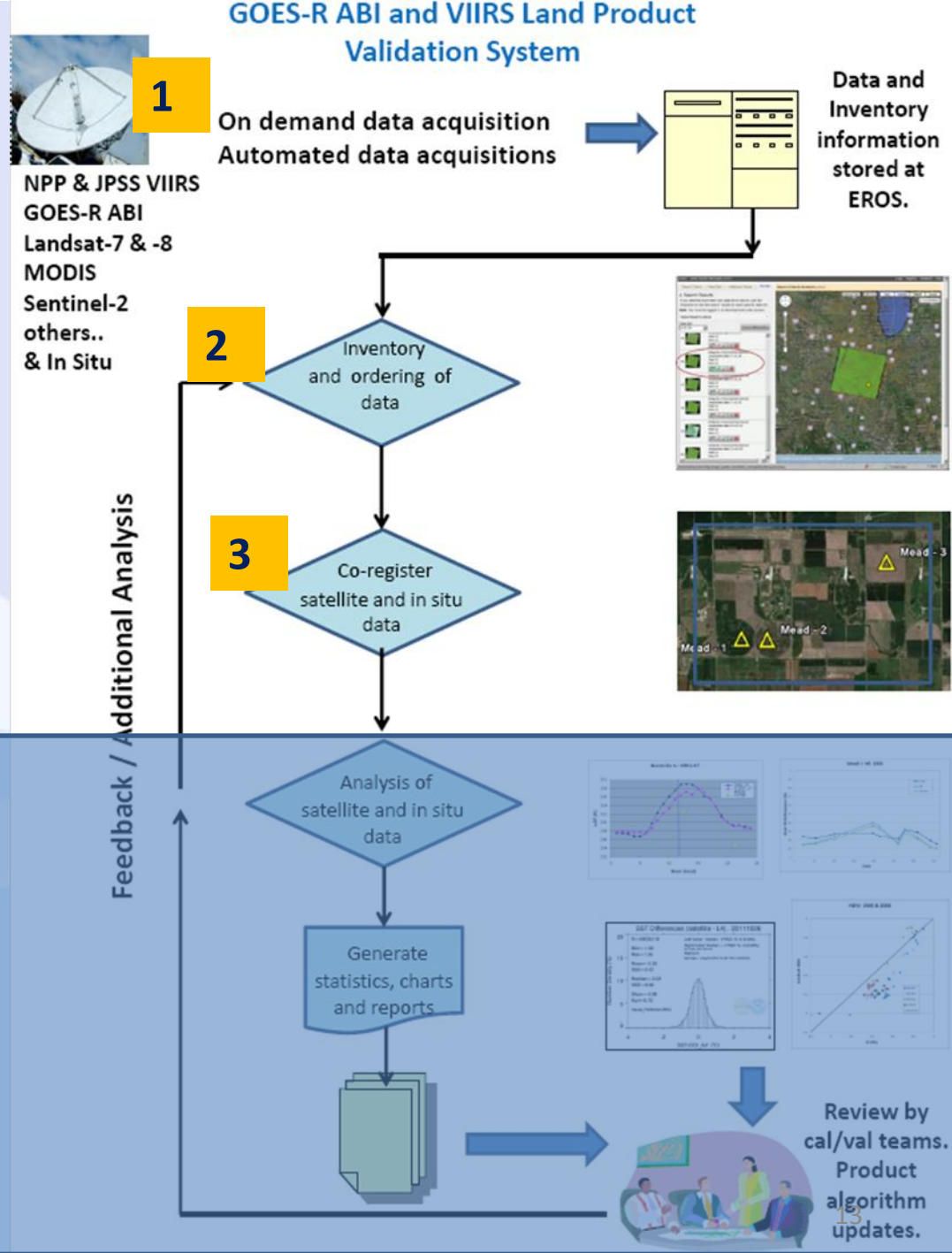
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2. Analysis Tools

Path Forward

Summary

Why LPVS developed and hosted at USGS/EROS?

1. Facility Assets
2. Landsat
3. Landsat product development



Why LPVS developed and hosted at USGS/EROS?

1. Facility Assets
2. Landsat characteristics
3. Landsat product development

Landsat 8



Launched 11 Feb. 2013

LDCM (Landsat 8)

11 Bands

9 vis to mid-IR; 15-30 m resolution

2 thermal IR; 100 m resolution ➡ 30 m

Absolute calibration of OLI and TIRS

Bands	Wavelength (micrometers)	Resolution (meters)
Band 1 - Coastal aerosol	0.43 - 0.45	30
Band 2 - Blue	0.45 - 0.51	30
Band 3 - Green	0.53 - 0.59	30
Band 4 - Red	0.64 - 0.67	30
Band 5 - Near Infrared (NIR)	0.85 - 0.88	30
Band 6 - SWIR 1	1.57 - 1.65	30
Band 7 - SWIR 2	2.11 - 2.29	30
Band 8 - Panchromatic	0.50 - 0.68	15
Band 9 - Cirrus	1.36 - 1.38	30
Band 10 - Thermal Infrared (TIRS) 1	10.60 - 11.19	100
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http://landsat.usgs.gov/band_designations_landsat_satellites.php

Landsat characteristics

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VIIRS

VIIRS Band	Spectral Range (um)	Nadir HSR (m)
DNB	0.500 - 0.900	750
● M1	0.402 - 0.422	750
● M2	0.436 - 0.454	750
● M3	0.478 - 0.498	750
● M4	0.545 - 0.565	750
I1	0.600 - 0.680	375
● M5	0.662 - 0.682	750
● M6	0.739 - 0.754	750
I2	0.846 - 0.885	375
● M7	0.846 - 0.885	750
M8	1.230 - 1.250	750
M9	1.371 - 1.386	750
I3	1.580 - 1.640	375
M10	1.580 - 1.640	750
M11	2.225 - 2.275	750
I4	3.550 - 3.930	375
M12	3.660 - 3.840	750
M13	3.973 - 4.128	750
M14	8.400 - 8.700	750
M15	10.263 - 11.263	750
I5	10.500 - 12.400	375
M16	11.538 - 12.488	750

● Dual-gain Band

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GOES-R ABI

Visible/NIR

Future GOES imager (ABI) band	Wavelength range (μm)
1	0.45–0.49
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GOES-R ABI
IR Bands

7	3.80–4.00
8	5.77–6.6
9	6.75–7.15
10	7.24–7.44
11	8.3–8.7
12	9.42–9.8
13	10.1–10.6
14	10.8–11.6
15	11.8–12.8
16	13.0–13.6

Why LPVS developed and hosted at USGS/EROS?

1. Facility Assets
2. Landsat
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CDRs and ECVs (some available starting in Q3 2014)

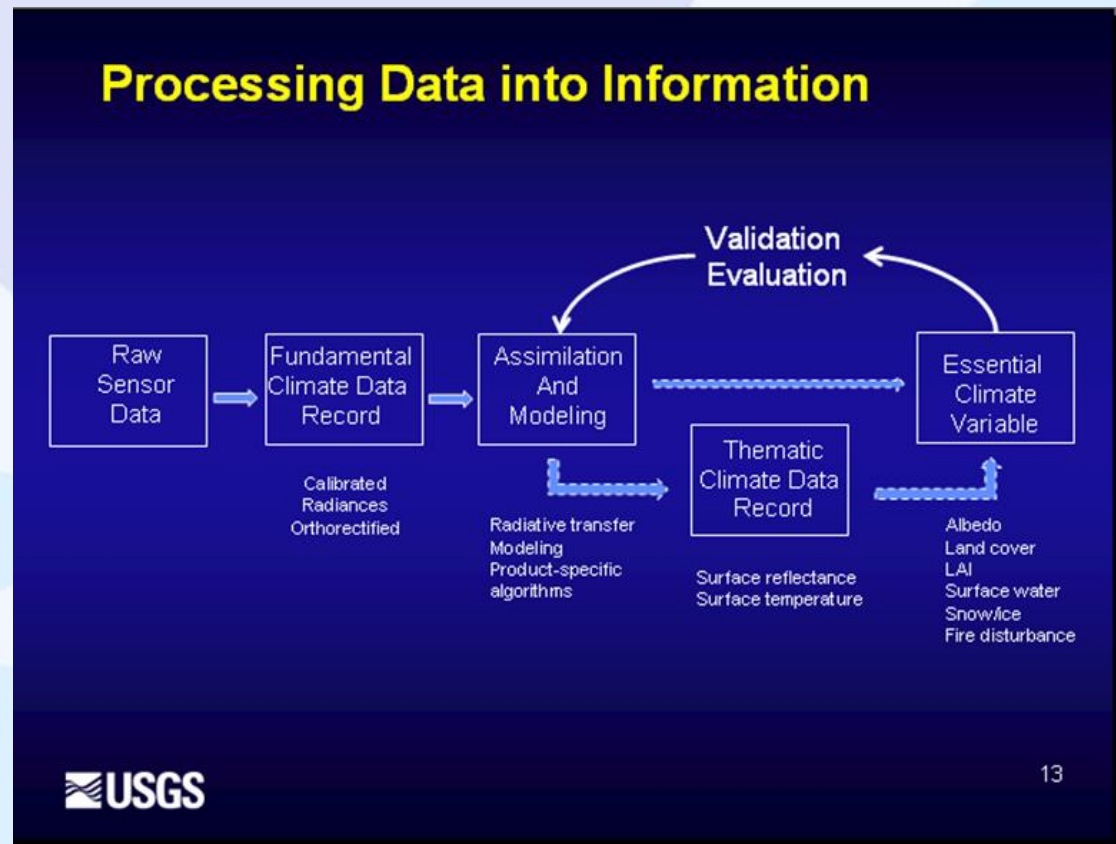
CDRs

Surface Reflectance (and NDVI),
Land Surface
Temperature/Emissivity

ECVs

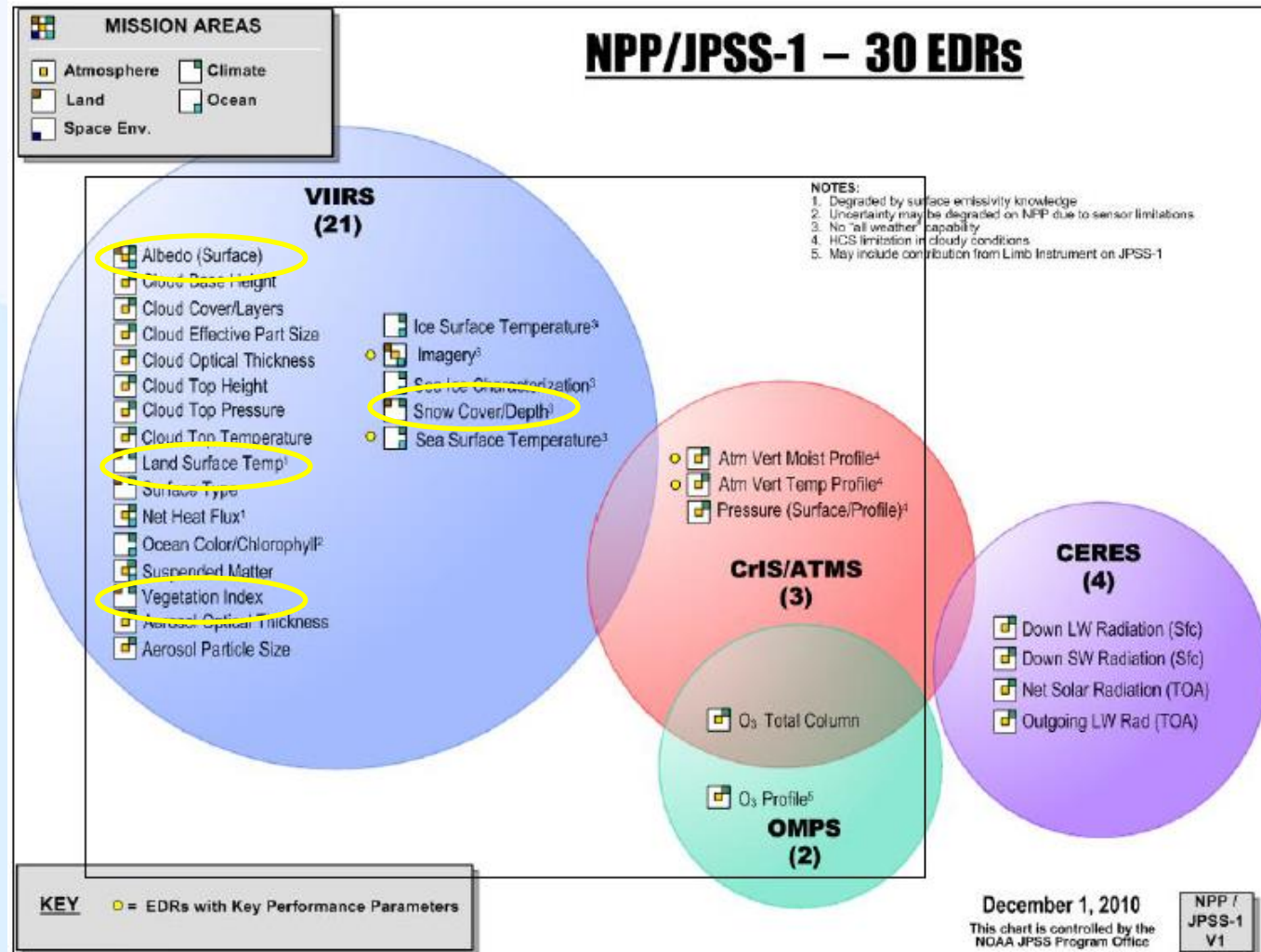
Surface Water Extent,
Burned Area Extent,
Snow Covered Area

Landsat Product Development



EROS-NOAA validation synergy

Several products of mutual interest
(e.g. VIIRS)



EROS-NOAA validation synergy

Several products of mutual interest
(e.g. GOES-R ABI)

KEY

ABI	SUVI	EXIS
GLM	SEISS	MAG

ABI: Advanced Baseline Imager
SUVI: Solar Ultraviolet Imager
EXIS: Extreme Ultraviolet and X-ray Irradiance Suite
GLM: Geostationary Lightning Mapper
SEISS: Space Environment In-Situ Suite
MAG: Magnetometer

BASELINE PRODUCTS

Aerosol Detection (Including Smoke and Dust)
Aerosol Optical Depth (AOD)
Volcanic Ash: Detection and Height
Cloud and Moisture Imagery
Cloud Optical Depth
Cloud Particle Size Distribution
Cloud Top Phase
Cloud Top Height
Cloud Top Pressure
Cloud Top Temperature
Hurricane Intensity
Lightning Detection: Events, Groups & Flashes
Rainfall Rate / QPE
Legacy Vertical Moisture Profile
Legacy Vertical Temperature Profile
Derived Stability Indices
Total Precipitable Water
Clear Sky Masks
Radiances
Downward Shortwave Radiation: Surface
Reflected Shortwave Radiation: TOA
Derived Motion Winds
Fire/Hot Spot Characterization
Land Surface Temperature (Skin)
Snow Cover
Sea Surface Temperature (Skin)
Energetic Heavy Ions
Mag. Electrons & Protons: Low Energy
Mag. Electrons & Protons: Med & High Energy
Solar & Galactic Protons
Geomagnetic Field
Solar Flux: EUV
Solar Flux: X-Ray
Solar Imagery: X-Ray

OPTION 2 PRODUCTS

Aerosol Partical Size
Aircraft Icing Threat
Cloud Ice Water Path
Cloud Layers/Heights
Cloud Liquid Water
Cloud Type
Convective Initiation
Enhanced "V" / Overshooting Top Detection
Low Cloud and Fog
Tropopause Folding Turbulence Prediction
Visibility
Probability of Rainfall
Rainfall Potential
Absorbed Shortwave Radiation: Surface
Downward Longwave Radiation: Surface
Upward Longwave Radiation: Surface
Upward Longwave Radiation: TOA
Ozone Total
SO2 Detection
Flood/Standing Water
Ice Cover
Snow Depth (Over Plains)
Surface Albedo
Surface Emissivity
Vegetation Fraction: Green
Vegetation Index
Currents
Currents: Offshore
Sea and Lake Ice: Age
Sea and Lake Ice: Concentration
Sea and Lake Ice: Motion

Why LPVS developed and hosted at USGS/EROS

Sentinel-2

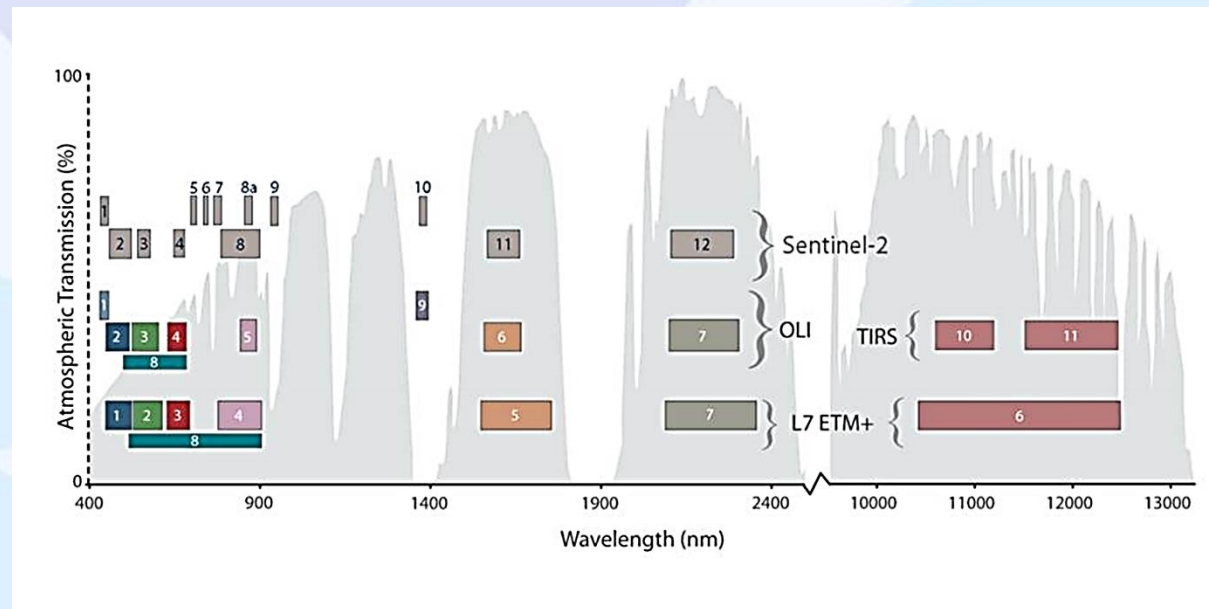
13 Bands

4 bands at 10 m resolution

6 bands at 20 m

3 bands at 60 m

Landsat-7, Landsat-8 and Sentinel-2 Spectral Bands



→ SENTINEL-2

Anticipated launch 2015

Land Product Validation System (LPVS)

What is LPVS

Why LPVS developed/hosted at EROS

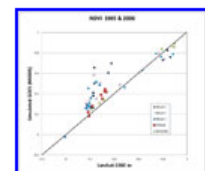
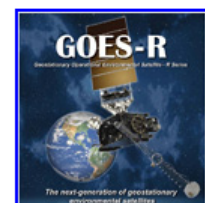
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Summary

Land Product Validation System (LPVS)



Within the next few years the National Oceanic and Atmospheric Administration (NOAA) will launch two environmental satellites, the Geostationary Operational Environmental Satellite - R Series (GOES-R), and the Joint Polar Satellite System (JPSS). Each will carry instruments to monitor current meteorological conditions, observe information for use in numerical weather prediction models, and provide high quality products for monitoring trends in the long-term climate.

The U.S. Geological Survey (USGS) Earth Resources Observation and Science Center (EROS) is collaborating with NOAA to develop a *Land Product Validation System (LPVS)*. This system will facilitate the characterization and validation of land-related products from GOES-R and JPSS (e.g., surface reflectance, Normalized Difference Vegetation Index, and Land Surface Temperature). The LPVS plans to utilize data from the USGS Landsat satellites, the European Space Agency (ESA) Sentinel series, and others, to validate land products from the GOES-R Advanced Baseline Imager (ABI) and JPSS Visible Infrared Imager Radiometer Suite (VIIRS) sensors. The LPVS will also be useful for validation of the VIIRS products available from the Suomi NPP (National Polar-orbiting Partnership) satellite currently on orbit, as well as for characterization and validation of future Landsat-8 products.

The LPVS will include data access, inventory, and analysis functions so that data from multiple archives can be co-registered and compared statistically through a single interface. This functionality is evolving through a prototype phase (2012) and a beta operational phase (2013) before becoming operational in 2014. The land science community is encouraged to test LPVS capabilities, and is invited to provide feedback to the development project.

[Access LPVS Prototype Data Search and Retrieval Services](#)

[Access LPVS Prototype Test Site Trending](#)

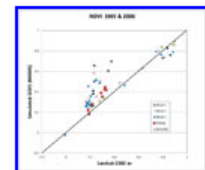
[Community Feedback Form](#)

[User Support](#)

Project Partners:



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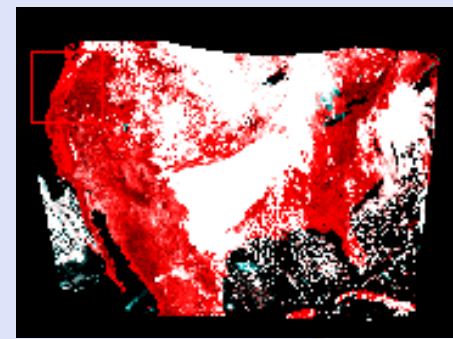
[User Support](#)

Project Partners:



<http://lpvsexplorer.cr.usgs.gov/>

Search for Landsat data on date of simulated
GOES-R ABI data : 23 April 2013 (provided by
Univ. Wisc./CIMSS).



LPVS  **USGS**
science for a changing world
Land Product Validation System

Land Product Validation System (LPVS) - Devsys

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Search Criteria **Data Sets** Additional Criteria Results

2. Select Your Data Set(s)
Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets.

☐ Use Data Set Prefilter [\(What's This?\)](#)

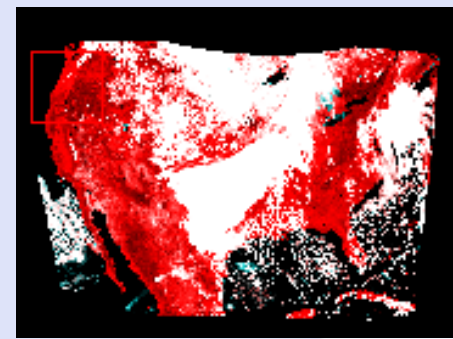
Data Set Search:

- ☒ **Landsat Archive**
 - ☒ L8 OLI/TIRS
 - ☐ LPVS - Landsat7 ETM+
 - ☐ LPVS - Landsat TM
- ☐ **Landsat CDR**
 - ☐ Land Surface Reflectance - GLS2010
 - ☐ Land Surface Reflectance - GLS2005
 - ☐ Land Surface Reflectance - GLS2000
 - ☐ Land Surface Reflectance - L7 ETM+
 - ☐ Land Surface Reflectance - L4-5 TM
- ☐ **NASA LPDAAC Collections**
 - ☐ MODIS Land Surface Reflectance
 - ☐ MODIS Land Surface Temp and Emiss
 - ☐ MODIS Vegetation Indices

Search Criteria Summary (Show) [Clear Criteria](#)

(69° 05' 59" N, 037° 47' 34" W) Options Overlays Map Satellite

Search for Landsat data on date of simulated
GOES-R ABI data (23 April 2013).



LPVS

USGS

Land Product Validation System

science for a changing world



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Land Product Validation System (LPVS) - Devsys

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Search CriteriaData SetsAdditional CriteriaResults

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/PlacePath/RowFeatureCircle

ShowClear

CoordinatesPredefined AreaShapefileKML

Degree/Minute/SecondDecimal

1. Lat: 47° 09' 35" N, Lon: 124° 48' 16" W

2. Lat: 48° 34' 29" N, Lon: 116° 11' 29" W

3. Lat: 41° 06' 45" N, Lon: 117° 04' 13" W

4. Lat: 40° 26' 48" N, Lon: 123° 55' 32" W

Use MapAdd CoordinateClear Coordinates

Date RangeResult Options

Search from: 04/23/2013 to: 04/23/2013

Search months: (all)

Data Sets »Additional Criteria »Results »

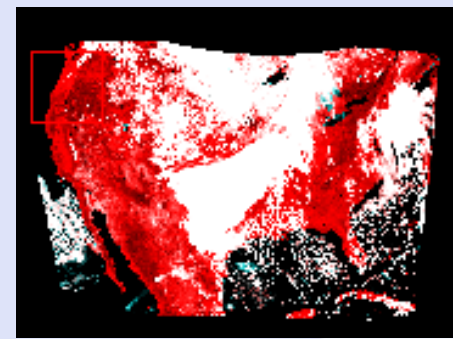
Search Criteria Summary (Show)Clear Criteria

(29° 32' 06" N, 152° 45' 14" W)OptionsOverlaysMapSatellite



28

Search for Landsat data on date of simulated
GOES-R ABI data (23 April 2013).



Search Criteria Data Sets Additional Criteria Results

4. Search Results






If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

Note: You must be logged in to download and order scenes

Show Result Controls

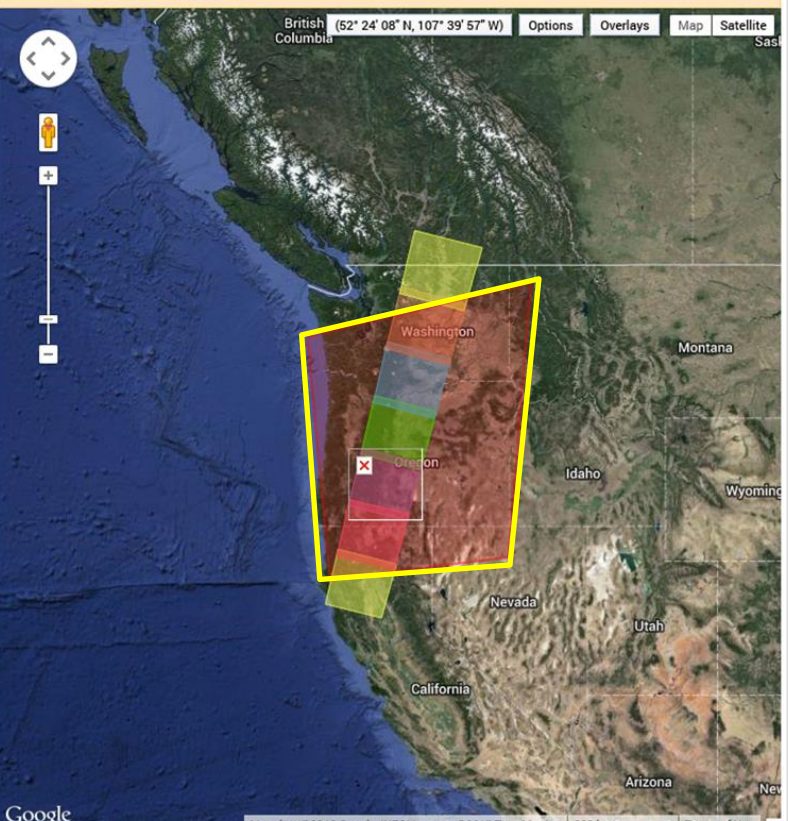
Data Set [Click here to export your results »](#)

L8 OLI/TIRS

3		Coordinates: 41.75975, -122.29287 Acquisition Date: 23-APR-13 Path: 45 Row: 31
4		Entity ID: LC80450272013113LGN01 Coordinates: 47.4492, -120.26091 Acquisition Date: 23-APR-13 Path: 45 Row: 27
5		Entity ID: LC80450282013113LGN01 Coordinates: 46.02972, -120.79977 Acquisition Date: 23-APR-13 Path: 45 Row: 28
6		Entity ID: LC80450292013113LGN01 Coordinates: 44.6082, -121.3167 Acquisition Date: 23-APR-13 Path: 45 Row: 29
		Entity ID: LC80450322013113LGN01 Coordinates: 40.33251, -122.75571

Search Criteria Summary (Show) Clear Criteria

British Columbia (52° 24' 08" N, 107° 39' 57" W) Options Overlays Map Satellite



Google

Map data ©2013 Google, INEGI Imagery ©2013 TerraMetrics 200 km Terms of Use

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Enhanced Landsat Products

Additional ECVs and CDRs will be added to menu as available.

Select Product Contents

Source Products

- ☐ [Source Products](#)
- ☐ [Source Metadata](#)

Climate Data Records

- ☐ [Top of Atmosphere Reflectance](#)
- ☐ [Surface Reflectance](#)
- ☐ [Band 6 Brightness Temperature](#)

Spectral Indices

- ☐ [Surface Reflectance NDVI](#)
- ☐ [Surface Reflectance NDMI](#)
- ☐ [Surface Reflectance NBR](#)
- ☐ [Surface Reflectance NBR2](#)
- ☐ [Surface Reflectance SAVI](#)
- ☐ [Surface Reflectance EVI](#)

Other Products

- ☐ [CFMask \(standalone file\)](#)
- ☐ [Solr Index](#)

Product Customization



Enhanced Functionality

- 1. Auto-registration of data to common map projections for analysis.
- 2. User defines area of interest for analysis
- 3. Match pixel size for all images
- 4. Several resampling options

Product Customization

☒ Reproject Products

1

Projection: Geographic

Geographic

Albers Equal Area

Sinusoidal

Universal Transverse Mercator

☒ Modify Image

2

Upper left X coordinate

Upper left Y coordinate

Lower right X coordinate

Lower right Y coordinate

☒ Pixel Resizing

3

Meters

4

Resample Method: Nearest Neighbor

Nearest Neighbor

Bilinear Interpolation

Cubic Convolution

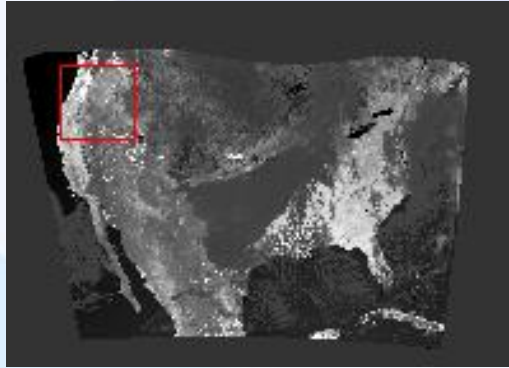
Order Description (optional)

Submit

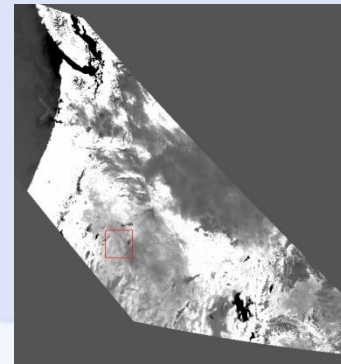
Example of New Functionality

Example of georegistration of ABI, VIIRS and Landsat for 23 April 2013.

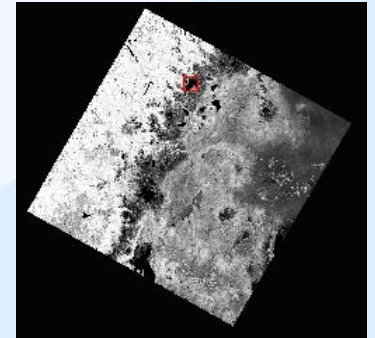
Simulated GOES-R ABI



VIIRS

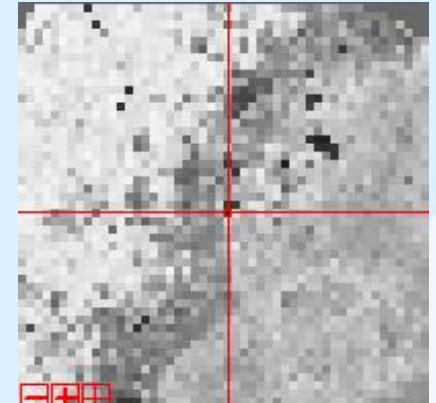
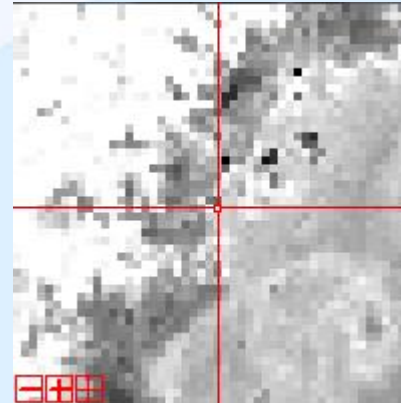
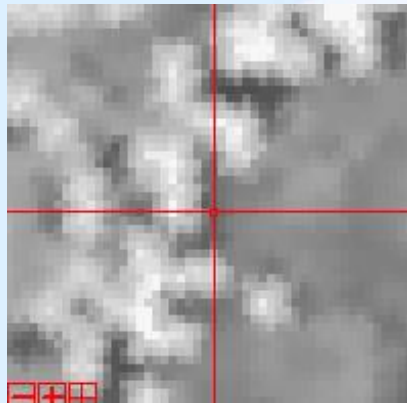


Landsat



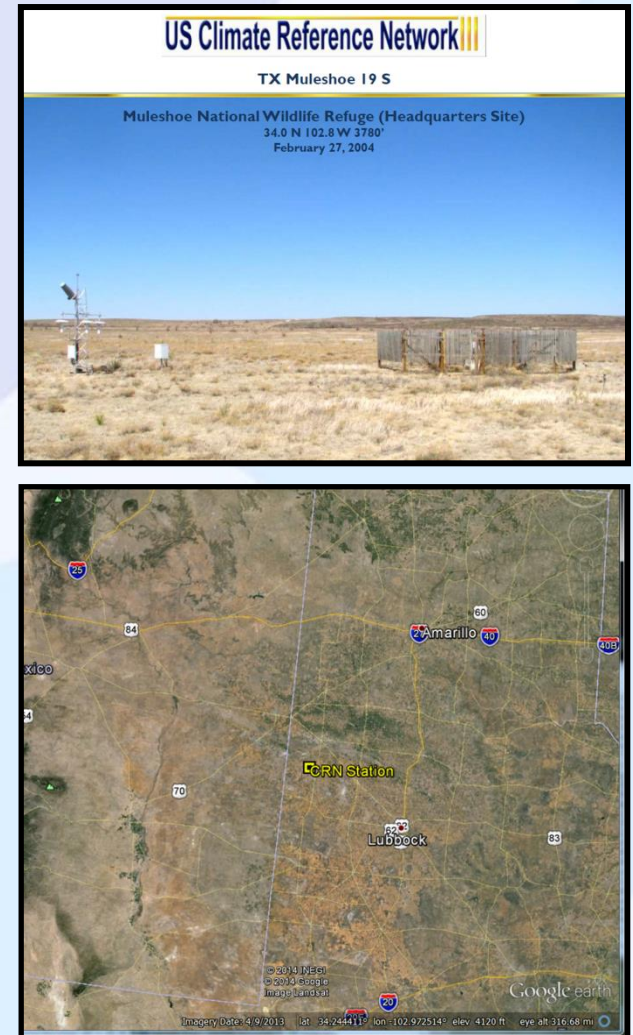
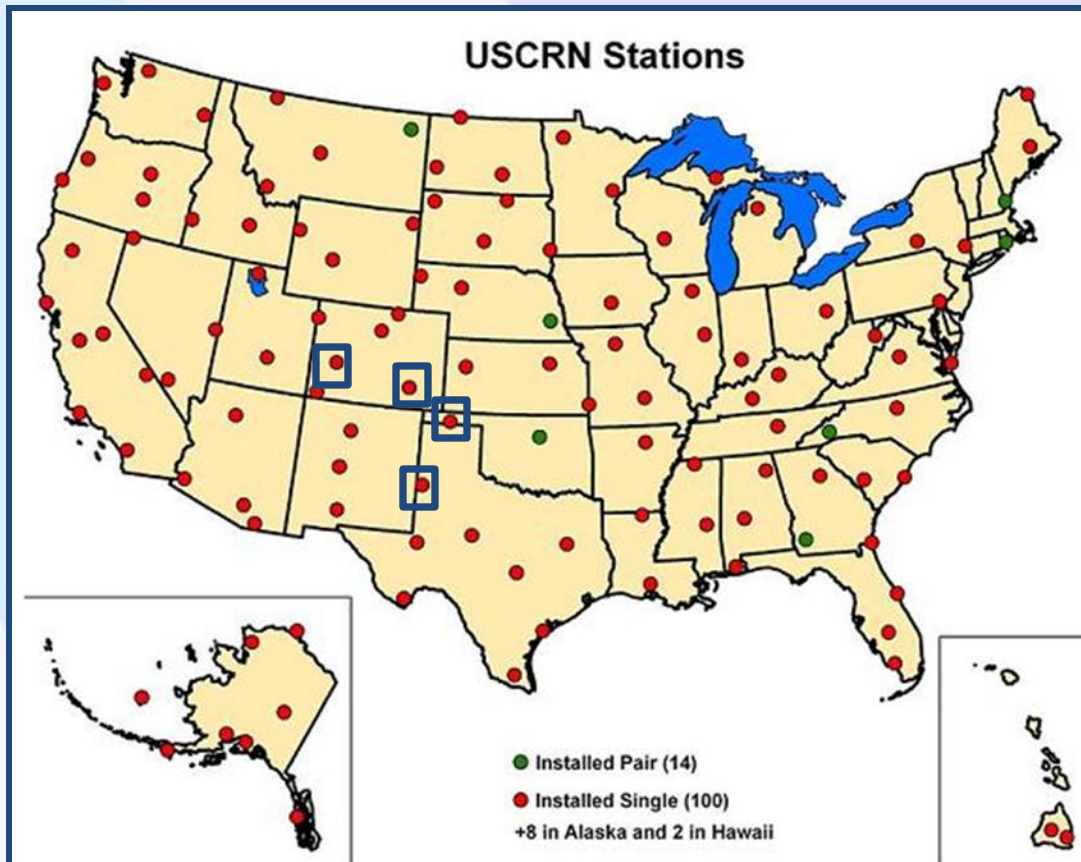
Georegistered Data

- Same Pixel Size: 2222 m
- Same Map Projection: Lambert Azm Eq Area



Example of New Functionality

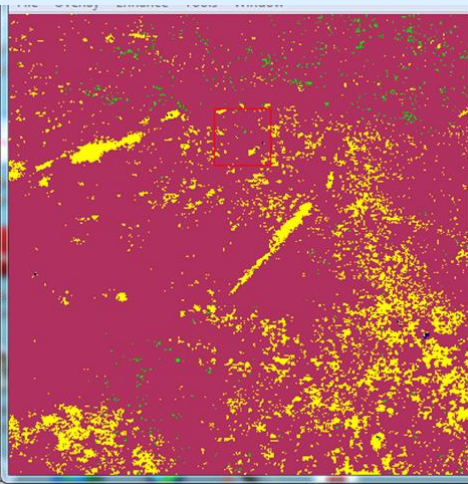
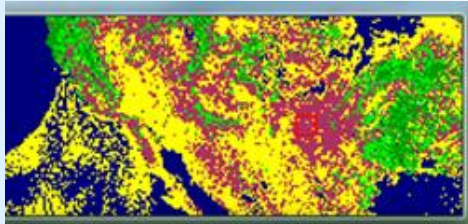
Data extracted for VIIRS (NOAA and NASA products) and Landsat 8 for four CRN stations located within NASA golden tile (h09v05).



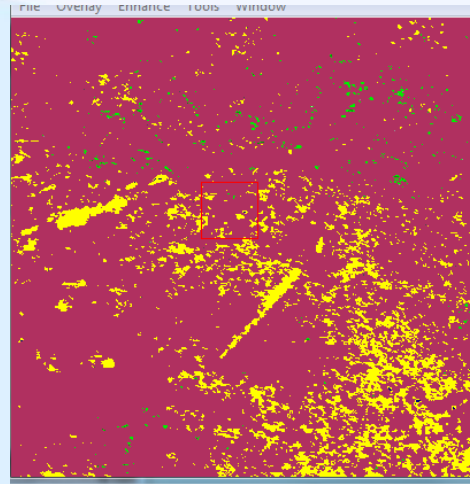
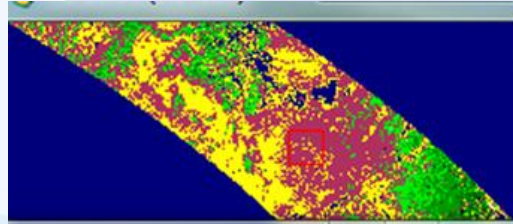
Example of New Functionality

Data extracted for VIIRS (NOAA and NASA products) and Landsat 8 for four CRN station locations (sample regions of 0.5 x 0.5 degrees).

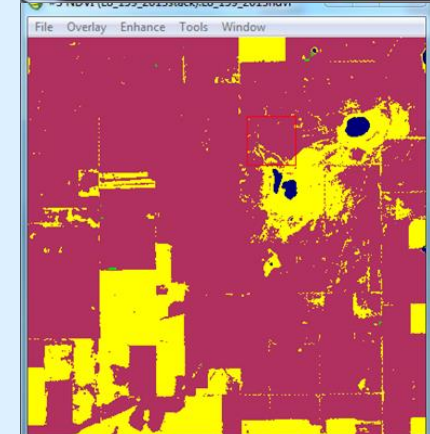
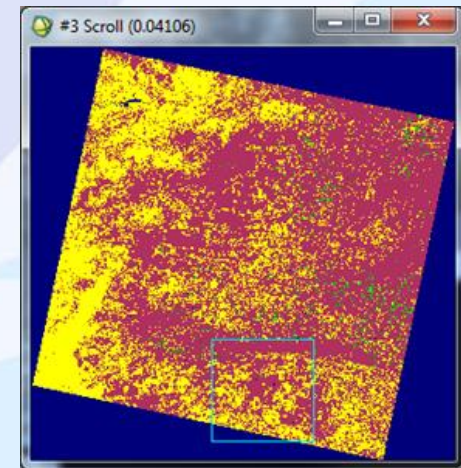
NOAA VIIRS
(STAR GVI Daily)



NASA VIIRS
(NPP_DSRFHKD_L2GD



Landsat 8



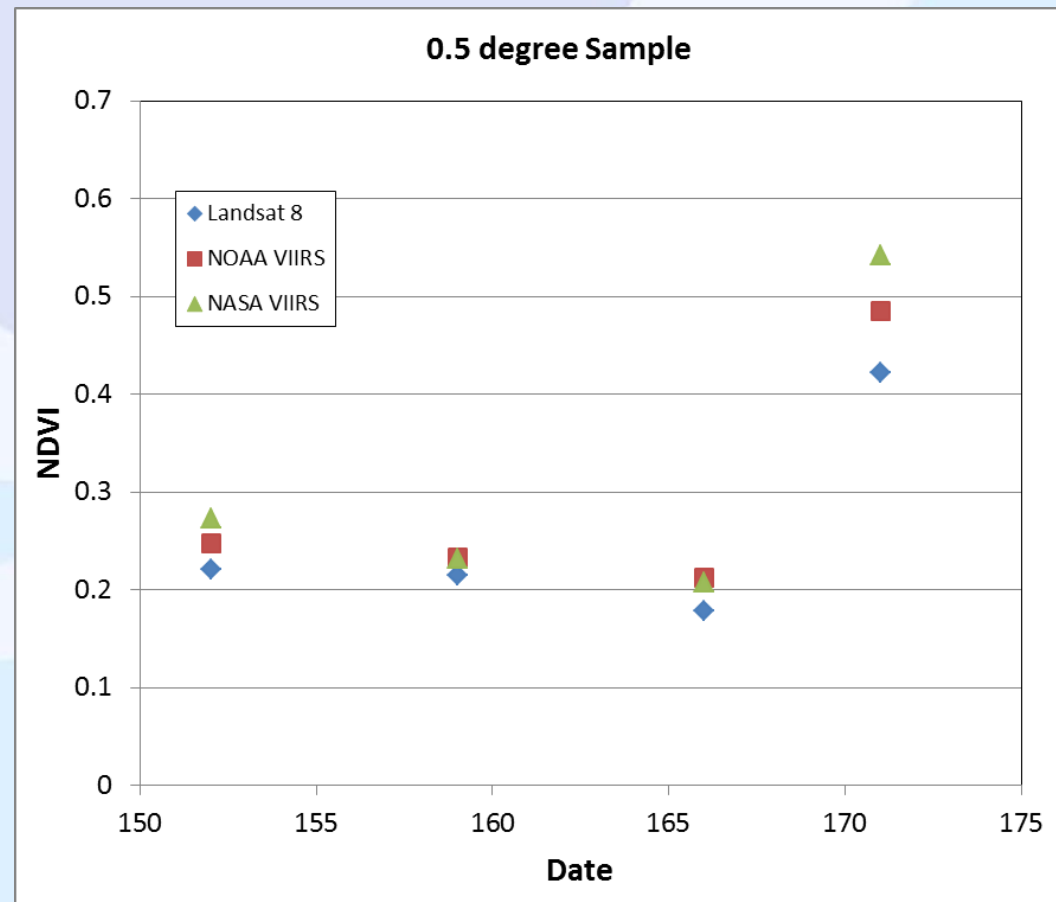
Example of Potential Analysis

Multisensor/multidate comparison for four CRN station locations in 2013:

- Goodwell, OK, day 152
- Muleshoe, TX, day 159
- LaJunta, CO, day 166
- Montrose, CO day 171

Data included in analysis:

- Landsat 8: TOA NDVI
- NOAA-VIIRS: TOA NDVI
- NASA-VIIRS: TOC NDVI



Each point within figures represents .5 x .5 degree sample

Land Product Validation System (LPVS)

What is LPVS

Why LPVS developed/hosted at EROS

Highlights of LPVS

1. Inventory & Ordering
2. Analysis Tools

Path Forward

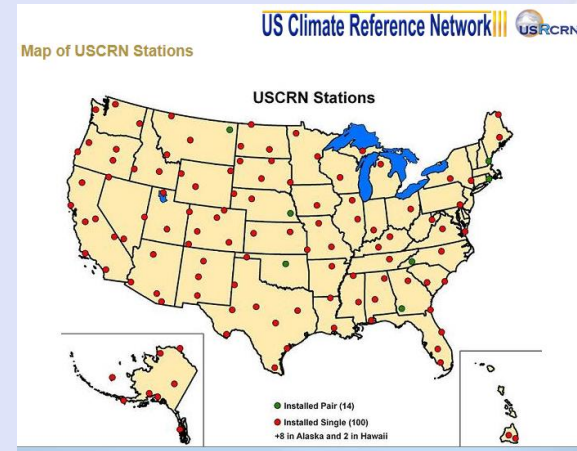
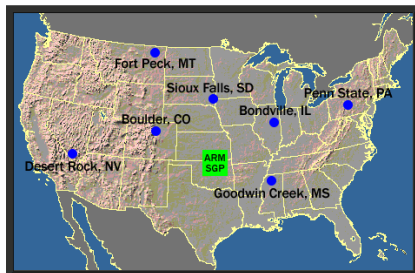
Summary

Predefined sample sites: user selectable for satellite (and potential in situ) inter-comparisons

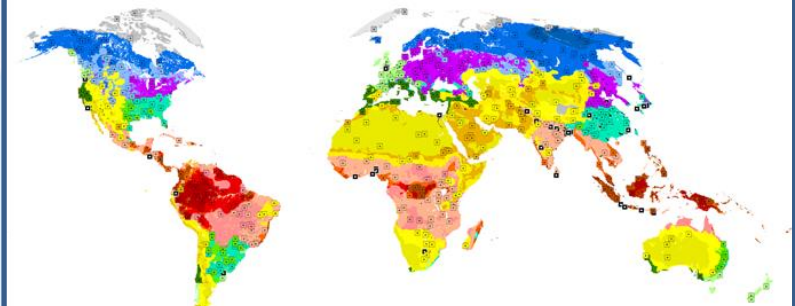


SURFRAD Site Information

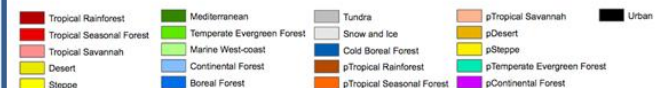
For information about a specific station within the SURFRAD network, click on its location on the map below, or use the links at the bottom of this page:



Global Land Cover Validation: Global Stratification and Sample Sites



From M. Roman, NASA



Land Product Validation System (LPVS)

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Path Forward

Summary

What is LPVS

A web-based system designed to use moderate to high-resolution satellite data for validation of GOES-R ABI and JPSS VIIRS products.

Ready for GOES-R and JPSS-VIIRS pre- and post-launch testing and validation.

